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THE MOSQUITOES OF THE GREATER WINNIPEG AREA

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INTRODUCTION

This study was an attempt to discover, for the Greater Winnipeg district, what species of mosquitoes occurred, under what conditions, their seasonal distribution, and the relative abundance of each species. The field work and preservation of the material were done by the writer in conjunction with his duties, first as Senior Foreman in 1938 and later, in 1939, as Field Manager of the Winnipeg Anti-Mosquito Campaign. The identifications and working over of the material were done during spare time and in the evenings of the succeeding winters; during the winter of 1938-'39 at the University of Manitoba and during 1939-'40 at the Dominion Entomological Laboratory in Brandon.

Apart from control, very little work has been done on the mosquitoes of the Winnipeg area and in fact in Manitoba. In 1907 F. Knab (2) made a collecting trip across Canada and took eight species at Winnipeg. In 1921-'22 Dr. Alex Robertson made a collection of the adult mosquitoes of rural Manitoba and found twenty-two different species. Dr. Robertson's collection is in now the Winnipeg Museum. Mr. J. Tully (17) undertook some research into the biology of *Aedes vexans* Meigen and *A. spencerii* Theobald and this is practically the only work on the biology of the species that has been done so far in this area.

TOPOGRAPHY

This survey covered an area of approximately one hundred square miles lying within what is known as the Red River Valley, a broad plain drained by the Red River and its tributaries. The area is roughly circular in outline with the City of Winnipeg situated at its centre. The information concerning the topography of this area was drawn chiefly from the work of W. A. Johnston (11).

The surface deposits consist mainly of a black clay soil formed by lake-bed and flood-plain deposition varying in depth from six inches to three feet. There is little or no relief, the surface being nearly level or sloping. In the centre of the area, at the junction of the Red and Assiniboine Rivers and covering an area of approximately thirty-six square miles, the surface deposit is formed from swamp and pond deposition and is therefore mainly organic; this is the surface on which the City of Winnipeg proper has been built and hence is a factor of little importance to the mosquito population since it is to a great extent covered by pavement and buildings. East of the Red River there are one or two swamps which offer excellent breeding places for mosquitoes and, being difficult to drain, present a serious problem in mosquito control.

Between nature and man the area has been roughly divided into four quarters. The Red River, flowing north, divides it into eastern and western halves; the Assiniboine River, flowing east to meet the Red, divides the western half into northwest and southwest quarters, and the C. N. R. main line, running due east from the junction of the two rivers, divides the eastern half into northeast and southeast quarters.

The natural drainage of the area is poor. Hearle (8) when speaking of mosquito control in Winnipeg said, "The poor drainage of extensive areas of uncultivated land surrounding the city results in the accumulation of much water during wet seasons, and the problem is one of very considerable magnitude". What drainage there is goes into Hudson Bay via the Nelson River, Lake Winnipeg, the Red

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and Assiniboine Rivers. The southeastern quarter is drained by the River Seine into the Red; the northeastern quarter by two creeks into the Red; the northwestern quarter by one creek into the Red and three creeks into the Assiniboine; and the southwest quarter is drained by two creeks into the Red. With the exception of Sturgeon Creek in the northwest, which is fed by springs, all the creeks are either dry or stagnant by the end of August. In recent years the drainage of the area has been augmented by many miles of ditches draining into the two principal rivers. In this way much of what was once permanent slough is now dry land, and of course drainage is always in progress where a cosmoplitan area is in the course of construction. Extensive cultivation has also done away with many of the early spring pools that were once such a prominent feature of the area.

VEGETATION AND CLIMATE

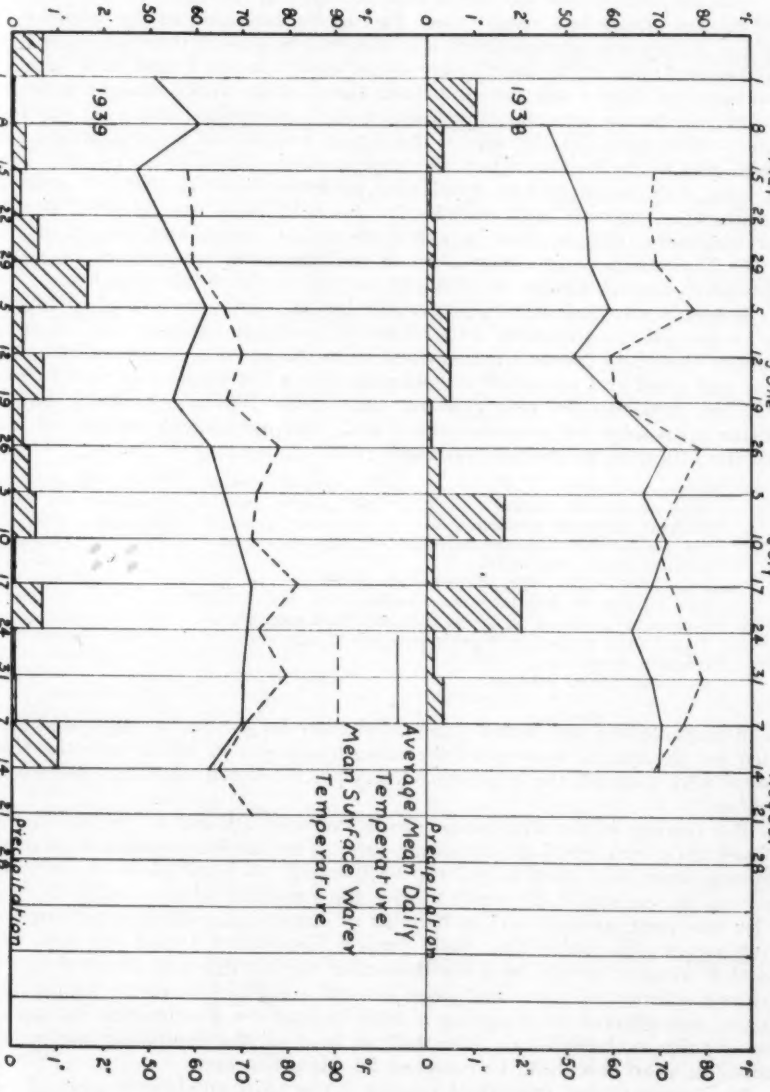
The climate of the area is that characteristic of an interior continental region. That is, the winters are severe, the summers hot, and precipitation is low compared with coastal regions. The mean temperature for July from 1873 to 1938 ranged from 59.5 in 1884 to 75.5 degrees (F) in 1936 and for January from -16.1 in 1883 to -11 degrees (F) in 1919. The temperature extremes are recorded as -52 to 108.5 degrees (F). Precipitation ranged from 14.36 inches in 1929 to 30.69 inches in 1876. By the end of September 1938, the precipitation for the area was 4.4 inches below normal, and the precipitation for the whole of 1938 was 15.38 inches which is only 1.46 inches above that of 1929, the recorded minimum precipitation for any one year. These conditions were more or less repeated in 1939 when the total precipitation for the year was 16.6 inches of which 5.5 inches fell in August. This heavy fall in August was soon soaked up by the dry ground and within a week or so no traces of it were visible on the surface.

Winnipeg is situated in a characteristic prairie region known as the first prairie level of Manitoba. Tree growth is general over the whole area but is most dense along the banks of the rivers; poplar, elm, maple and willow being predominant. Among the trees there is a heavy undergrowth consisting mainly of hazel and willow tangled with bindweed and vetches, making walking very difficult. On the upland edge of the woody vegetation along the rivers there are usually scrub oaks. Back from the rivers there is evidence of woodland invasion of the prairie in the groves of willow and poplar that abound in all directions; many of these groves are growing on land that was at one time under cultivation. The groves, well grown with broad-leaved herbs, catch and hold the snow during the winter and in spring form sloughs that persist for most of the summer. The vegetation supplies the protection from the sun and wind that would ordinarily be the drying agents.

Invasion of the prairie by woodlands may account in part for the large number of species of mosquitoes found within such a comparatively small area. The fauna of one region may be blending into that of the other. Rivers also, especially with a heavy tree growth on their banks, act as natural insect highways.

METHODS

The informaton for this survey was obtained by collecting adults and larvae in the field. On commencing the survey, it was intended to find a number of habitats which could be grouped into permanent, semipermanent and temporary pools, but as the summer of 1938 progressed it was found that the three rivers and one creek, together with one or two refuse pools from farms and dwellings, were the only permanent bodies of water in the area, the remainder being either semipermanent or temporary. Early in May, fifteen stations were chosen which, from the records of the Anti-Mosquito Campaign, were considered to be either permanent or semipermanent. By the end of July only three of these stations contained water, the remainder being either permanently dry or containing water only after heavy showers. The same was true for 1939 and



CLIMATE OF THE GREATER WINNIPEG AREA

can be accounted for only by the abnormally dry summers of 1938 and 1939. The plan of visiting predetermined statons at regular intervals had, therefore, to be abandoned. Instead, collections were made from all over the area throughout the seasons concerned.

The majority of the specimens were collected as larvae. For this purpose an aluminum dipper was used. Care had to be exercised in the manner in which the dipper was manipulated; if it was merely shoved into the water and dragged along, most of the larvae were swept away. It was found most satisfactory to turn the dipper sideways and make the dipping stroke straight down so as to draw the larvae into the dipper which was removed as soon as it was full of water. After each dip, the side of the dipper was tapped lightly, causing the larvae to dive to the bottom, when the surplus water could be poured off. The larvae were then transferred to a half-pint jar which was labelled and given a code number. Opposite each number in the field book was recorded details of the collection, that is, date, temperature of the water, and nature of the habitat. The samples were then taken to the laboratory where some or all of the specimens in each sample were reared through to the adult stage.

When it was desired to preserve the larvae, they were reared to fourth instar in pie plates containing water from the original habitat. On reaching the fourth instar, the larvae were strained from the water with an ordinary tea strainer and fixed and preserved by plunging into a hot solution of seventy per cent alcohol and two per cent glycerol; they could then be examined with a binocular microscope or mounted on slides. For permanent mounts of the larvae, the following procedure was used.

30% alcohol—30 minutes
distilled water—30 minutes
2% potassium hydroxide—overnight
distilled water—30 minutes
30%, 50%, 70%, 80% alcohol—each 30 minutes
95% alcohol—30 minutes (two changes)
4 parts 95% alcohol to 1 part creosote—30 minutes
1 part 95% alcohol to 4 parts creosote—30 minutes
creosote—20 minutes.
Mounted in gum dammar.

This procedure was found quite satisfactory for the larvae and could also be used for permanent mounts of the male hypopygia in which case the first two steps were omitted, the hypopygia being placed directly into the potassium hydroxide.

For rearing to the adult stage the larvae were allowed to pupate in the pie plates, then transferred to four-ounce jars. The jars were placed on a sheet of blotting paper and filled to the top with water. A small piece of cork was floated on the surface of the water to give the emerging adults a place to rest. The jar was next covered with a bell jar or battery jar which rested on the blotting paper. In order that their proper colouration would develop, the adults were allowed to live for a few days after the last one had emerged; dried raisins or a solution of water and sugar formed a satisfactory diet. Killing the specimens was effected by dropping a little chloroform on the blotting paper around the rim of the bell jar. After half an hour all the mosquitoes under the jar would be dead and could be removed for identification.

It is realized that individual rearing is the most satisfactory method for the purposes of record and identification, but the procedure is long and requires more time and attention than the writer has been able to spare during the past two years. However, in order that some use could be made of the larvae for identification purposes, some or all of the larvae in each sample were examined while they were still alive and their taxonomic characters noted. Larvae of the same species from each sample were reared together, and the adults that emerged

were checked with the larval descriptions. The larvae were examined alive by placing an individual on a slide with a drop of water and covering with a piece of cellophane. The cellophane held the larva in place without injuring the parts.

Table 1. Habitats and habits of mosquitoes of the Greater Winnipeg area.

SPECIES	LARVAL HABITAT	ADULT HABITAT	BEGINNING OF EMERGENCE	END OF EMERGENCE
		Major Importance		
Aedes campestris Dyar & Knab	Open pools, ditches	Grass	May	Late July
Aedes dorsalis Meigen	Open pools, ditches, woods	Grass	April	Late August
Aedes spencerii Theobald	Open pools	Grass	May	Mid June
Aedes vexans Meigen	Woods, open pools, ruts	Grass, houses	May	August
Culex tarsalis Coquillett	Barrels, ponds open pools	Grass, houses	July	Late Sept.
Culex territans Walker	Barrels, sloughs, ditches	Houses	June	Late Sept.
Theobaldia inornata Williston	Cool, shaded pools	Woods, houses	May	Frost
Aedes hirsuteron Theobald	Exposed ditches	Houses, bush	May	August
		Minor Importance		
Aedes fitchii Felt and Young	Railway ditches, open pools	?	May	Late May
Anopheles maculipennis Meigen	Edges of creeks & permanent sloughs	Houses, barns	July	Frost
		Little Importance		
Aedes canadensis Theobald	Woods, open pools	Houses, woods	May	Late July
Dedes cinereus Meigen	Open pools, sloughs, ditches	Woods	May	Late July
Aedes excrucians Walker	?	Woods	Prob. June	?
Aedes flavescens Muller	Ditches	Open prairie	May	Late June
Aedes impiger Walker	?	?	?	?
Aedes intrudens Dyar	Ditches	Houses, barns	?	?
Aedes nigromaculis Ludlow	Ditches	?	?	?
Aedes riparius Dyar & Knab	Ditches	?	May	Late May
Anopheles punctipennis Say	Ponds	?	July, Aug.	?
Culex apicalis Adams	Permanent pools & sloughs	Woods	June	Late Sept.
Taeniorhynchus perturbans Walker	?	Woods	?	?
Theobaldia impatiens Walker	Ponds	?	July, Aug.	?

No light traps were available for the large scale collection of adults, but whenever possible adults were collected by hand. The method used in capturing the adults consisted simply of allowing the mosquito to alight on the hand or arm, letting it start to feed, then placing a small cyanide bottle over it. Collections made in each locality at different times were kept separate in small match boxes and labelled for identification at a later date.

During 1938 the pH and a sample of the water were taken whenever larvae were found in the permanent pools. The water sample was taken for analysis in order to get some indication of the amount of dissolved oxygen present; pH values ranged from 6.7 to 8.8 and dissolved oxygen from an undetectable amount to 9.5 cc. per litre. No correlation could be found between pH and dissolved oxygen with the incidence of larvae, and consideration of these two factors was discontinued during 1939. It must be noted, however, that the Winkler method was used for estimating the dissolved oxygen, and that if nitrites are present the Winkler method is useless. Since no abnormally high values were obtained the amount of nitrites present must have been negligible. The amount of oxygen required by the larvae for survival [Lo-Shan, Wang (18) and M. O. T. Iyengar (10)] is evidently very small, and an investigation into the specific amounts necessary is beyond the scope of this work. The lack of correlation between pH and larval incidence supports the findings of J. H. Bodine (1) and Senior-White (16). However, MacGregor (14) has suggested that the pH, without having any direct effect on the larvae, may be an indication of the chemical and biological conditions of the water necessary for the presence of the organisms upon which the larvae depend for their existence.

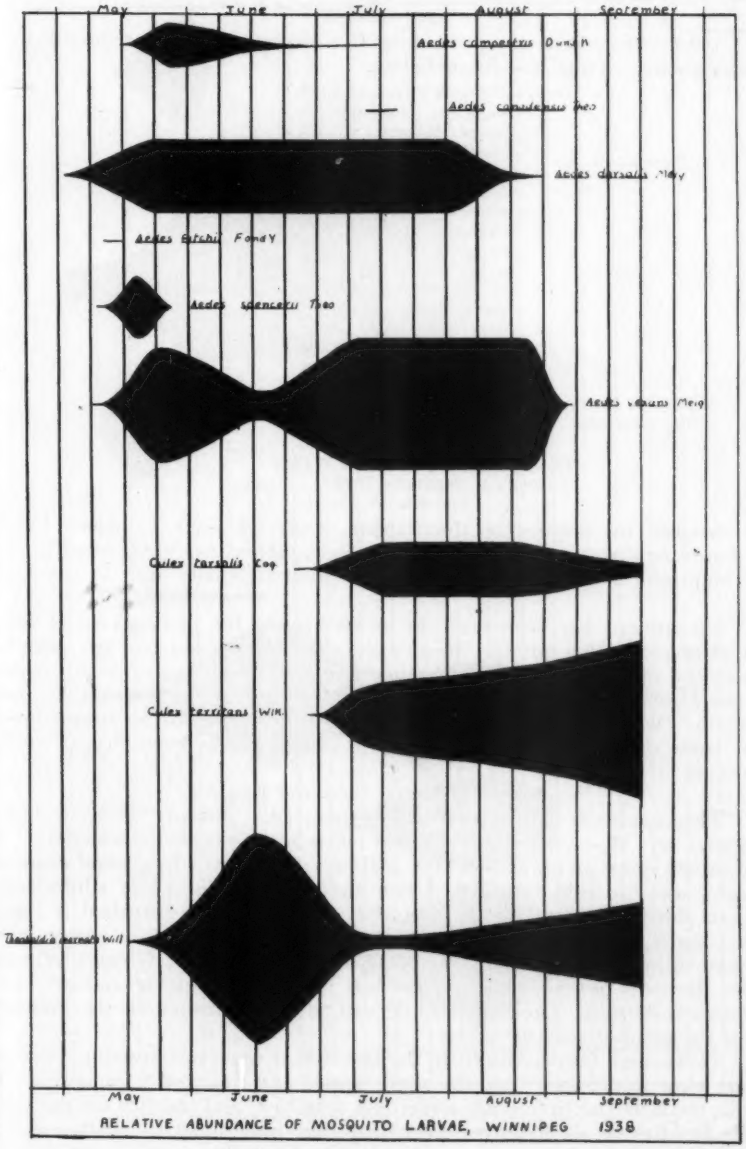
In all, one hundred and eighty-six samples were collected and identified, comprising fifty-nine hundred specimens, plus one hundred and seventy adults by hand collection. The keys used for identification were those of Matheson (13), Owen (15), Dyar (4) and Mail (12).

LARVAL SEQUENCE AND ABUNDANCE

Some species have only one generation in a season, while others have two or more. The eggs of certain species require stimuli such as freezing or high temperatures before they will hatch. In the case of others, all the eggs will not hatch at the first submergence in water and doubtless, as many writers contend, there are species which require the presence of various chemical and organic factors before they can develop. As a result it is found that in many habitats, particularly those of a permanent or semipermanent nature, there is a succession of species in the course of a season. But the first species to appear in a pool is not always the first to disappear; there is an overlap of generations, and this overlap is reflected in the adult population. Table I shows the type of habitat in which each species is found most frequently together with the beginning and end of emergence in the Winnipeg area.

Obtaining a reliable estimate of the specific number of larvae present within an area at any one time is virtually impossible. During the past two or three years, the area of water breeding mosquitoes around Winnipeg has varied throughout each season from one or two acres to 50 or 60 acres. One trained worker would be required for each pool, and many of the pools are so large and variable in outline, depth, and larval distribution as to defy even approximate measurement. However, some measure of the relative abundance of the different species can be obtained.

The control operations of the Anti-Mosquito Campaign normally require 6 or 7 complete oilings in the course of a season. Oiling is postponed until larval development has reached its maximum, that is, until third and fourth instar larvae begin to appear. Larval collections were made between and just before oilings in a uniform manner from all over the area. The percentage represented by each species of the total collected should give some estimate of the relative abundance of each. This was calculated and the results are shown graphically for the nine most important species in the area. The charts, besides giving relative abundance, also show the seasonal distribution of the larvae of the species represented. The abrupt end of the bars in August of 1939 and September of 1938 indicates when the field work was discontinued. It should be remembered, however, that both 1938 and 1939 were abnormally dry seasons. In such



RELATIVE ABUNDANCE OF MOSQUITO LARVAE, WINNIPEG 1938

seasons permanent and semipermanent pools are predominant. In a wet season, with plenty of temporary rain pools, the proportion of aedines would probably be much higher.

THE SPECIES

Twenty-two species, representing five genera, have been found in the Winnipeg area. These are listed below.

Aedes campestris Dyar and Knab
canadensis Theobald
cinereus Meigen
dorsalis Meigen
excrucians Walker
fitchii Felt and Young
flavescens Muller
hirsuteron Theobald
impiger Walker
intrudens Dyar
nigromaculis Ludlow
riparius Dyar and Knab
spencerii Theobald
vexans Meigen
Anopheles maculipennis Meigen
punctipennis Say
Culex apicalis Adams
tarsalis Coquillett
territans Walker
Taeniorhynchus perturbans Walker
Theobaldia impatiens Walker
inornata Williston

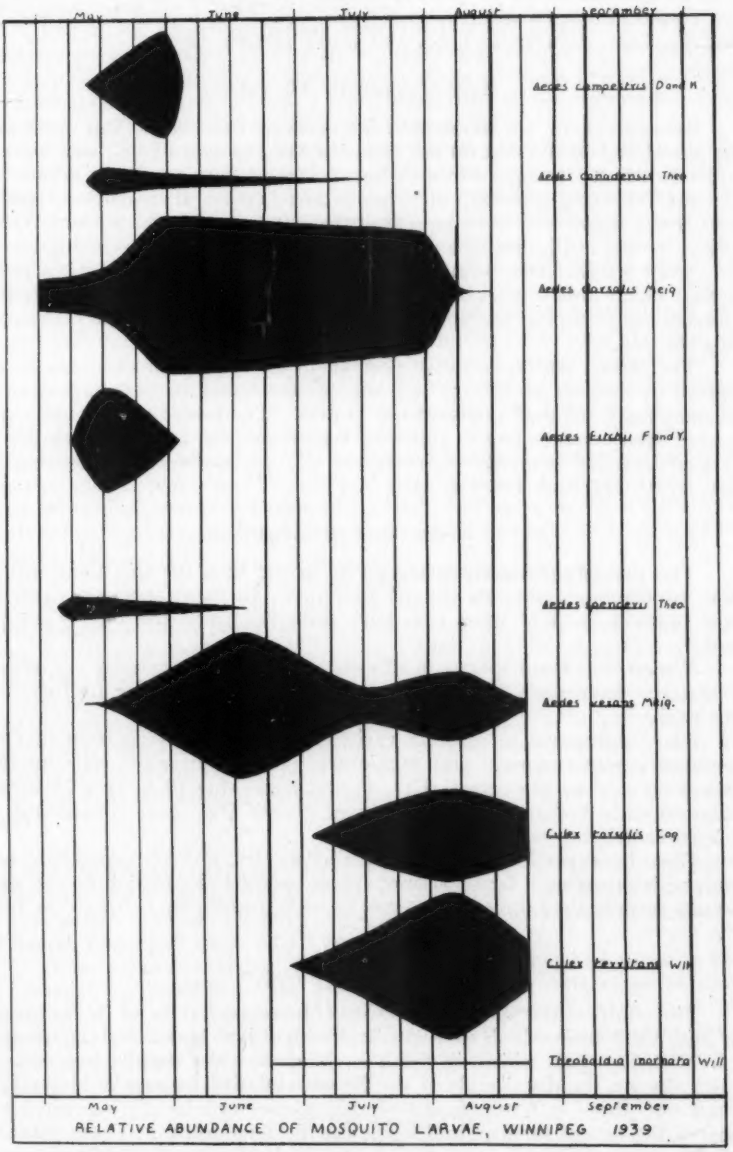
Despite its world-wide distribution, *Culex pipiens* Linnaeus has not been found in this survey. As far as is known, *pipiens* has never been reported from Manitoba although it does occur in eastern Canada and on the Pacific coast.

No attempt has been made at uniformity in the descriptions of the individual species which follow. Most of the taxonomic characters are quite fully given in the various publications dealing with the mosquitoes of North America and the United States. Any attempt to do the same here would be useless repetition. Where the taxonomic characters were found to be noticeably different from those given in the literature, attention has been drawn to these differences.

Aedes campestris Dyar and Knab

This species is easily confused, with *Aedes dorsalis* Meigen, but in *campestris* vein R_4+_5 has the black and white scales evenly intermixed. The broad brown stripe on the mesonotum is always undivided. In general *campestris* is larger, and the colouration is darker than in *dorsalis*. The adults rest in the grass during the heat of the day and will feed when disturbed if there is not too much wind. They feed readily at night and constitute a major pest to man and animals, particularly around dairy farms. In the Greater Winnipeg district they are present in great numbers only in the spring and are not as numerous as *dorsalis*. Occasional adults can be taken throughout the summer as long as the weather remains warm.

There are a few variations in the larvae that were encountered. The anal gills are sometimes longer than the anal segment and rounded at their tips. The last two teeth on the siphon are sometimes detached, and the tuft on the siphon usually has five or six hairs instead of the four mentioned by Matheson (13). Both pairs of head hairs are occasionally double. The earliest specimens of larvae were taken on May 10 and the latest on July 15. They are found in temporary or semipermanent pools formed by the melting snow or heavy rains. The pools usually have mud and grass bottoms and are in the open or around refuse dumps. Roadside ditches are also a favoured habitat. The larvae have been taken from water with temperatures ranging from 12 to 30 degrees (C).



RELATIVE ABUNDANCE OF MOSQUITO LARVAE, WINNIPEG 1939

There appears to be but one generation a year. Mail (12) has shown that the eggs of this species are very resistant to adverse conditions such as desiccation and prolonged immersion in water at temperatures slightly above freezing.

Found associated with *Aedes dorsalis* Mg., *Aedes vexans* Mg., *Aedes fitchii* F. and Y., *Aedes canadensis* Theo. and *Culex tarsalis* Coq.

Aedes canadensis Theobald

Recognized by the reddish-brown mesonotum; black legs with narrow white apical and basal rings on the tarsi, the last segment of the hind tarsi being completely white. Being a forest-loving species, *Aedes canadensis* is not numerous about Winnipeg although at times it does become a nuisance. Hearle (8) reports *Aedes canadensis* as being one of the important species around Winnipeg in 1927. It was not found in any great numbers in the course of this survey.

Adult females have been taken from June 20 till July 30 but can probably be found much later than this. They have been observed in and near human habitations and poplar bluffs on the edge of the prairie. They bite readily during the day.

The larvae can be found in permanent and semipermanent pools usually protected by trees or shrubbery. On one or two occasions they have been taken from temporary, exposed pools on the prairie. The larvae appear early in May and have been taken as late as July 12. Water temperatures in which the larvae were found ranged from 12 to 35 degrees (C). Usually found associated with *Aedes vexans* Mg. and *Aedes dorsalis* Mg.

Aedes cinereus Meigen

The distinguishing character given in the keys for this mosquito is the lateral, continuous, light line on the abdomen. In many specimens this line is broken, and in the few males that have been examined the line is completely absent.

Not an important species in this district, and its occurrence is rare. Adults can be taken from early May all through the summer till late in July; usually in the bush.

The larvae seem to prefer a variety of habitats, having been taken from permanent, semipermanent, and temporary locations in water varying in temperature from 12 to 30 degrees (C). Found from May 10 to July 28 usually in association with *Aedes dorsalis* Mg., *Aedes vexans* Mg., *Aedes canadensis* Theo. and *Theobaldia inornata* Will.

This is a predominantly woodland species, and its occurrence around Winnipeg is probably a factor accompanying woodland invasion of the prairies. Dyar (2) records the taking of this species at Winnipeg by F. Knab on June 22, 1907.

Aedes dorsalis Meigen

The adults of this species are easily confused with those of *Aedes campestris* Dyar and Knab from which they can be distinguished by the lighter colouration and by vein R_4+_5 on which, in *dorsalis*, the dark scales usually predominate as they do also on the distal ends of the fourth and fifth veins. As Mail (12) has pointed out, three different forms of this species can be distinguished by the nature of the brown longitudinal stripe on the mesonotum. These three forms merge together, but at the extremities there is the "eastern" form with a narrow stripe and the "lativittatus" form with a broad stripe. Between these two, variations occur but usually the "curriei" form, which has a divided stripe, predominates. The three forms occur about Winnipeg, the "eastern" and "curriei" forms being most common. The "lativittatus" form is the one most easily confused with *A. campestris.*

Adults can be taken from early summer till the end of August. They constitute one of the major pests of this area, being very numerous and severe biters. Generation follows generation all summer, at least as close as two weeks apart, depending on weather conditions.

The larvae have been found from April 28 till August 18. They seem to prefer temporary exposed pools but on occasion are found in permanent water, both stagnant and running. Early spring pools in small prairie wooded areas also have their quota of *dorsalis*. The temperature of the water from which the larvae were taken varied from 12 to 30 degrees (C).

The characters of the larvae taken varied considerably from those given in the keys and descriptions, the larvae resembling more closely the descriptions of *Aedes communis* De Geer. The anal gills are usually described as being short and stump-like, yet in a large proportion of the specimens taken the anal gills were at least half as long or slightly longer than the anal segment and were pear-shaped. The upper head hairs may be double; both upper and lower may be double, or the lower head hairs may be two and the upper three. The lateral abdominal hairs may be double on all the segments, or multiple on the first, second, and third segments, or they may be multiple on only the first segment and double on the remainder. The antennae are usually slightly curved, and one or two of the scales at the side of the lateral comb of the eighth segment may have a long central thorn. As Mail (12) has observed, there are also differences in the proportions of the breathing siphon..

The larvae of a species that occurs most of the summer and in such large numbers can be expected to associate with a large number of other species. Those most often found in association with *dorsalis* were *Aedes campestris* D. and K., *Aedes vexans* Mg., *Culex tarsalis* Coq., *Culex territans* Wlk. and *Theobaldia inornata* Will.

Aedes excrucians Walker

Recognized by its large size, the broad median bronzy-brown stripe on the mesonotum, the wing scales which are mottled black and white, especially along the costal margin, and by the broad bands of yellowish-white scales on the tarsi of the hind legs.

A severe biter, but fortunately its presence in the Winnipeg area is rare. Dyar (2) reports the taking of this species by F. Knab at Winnipeg on June 22, 1907. Only three specimens were taken in the course of this study, and the breeding place of the larvae could not be found. Adults were taken from June 25 to July 9 in the wooded sections of the area but probably can be found much later.

Aedes fitchii Felt and Young

This species is not very abundant. It is one of the early spring species, but no adults were taken in the course of this study. Owen (15) states that the "adults persist through the early summer". Dyar (2) reports the taking of this species at Winnipeg by F. Knab on June 22, 1907.

The larvae have been taken from railway ditches and pools in the open surrounded by shrubbery, from May 10 till May 30. The range of water temperatures in which larvae were found was very limited, being from 13 to 19 degrees (C). The eggs evidently begin to hatch as soon as the snow has melted. Usually found in association with *Aedes campestris* Dyar and Knab, *Aedes canadensis* Theo. and *Aedes dorsalis* Mg.

Aedes flavescens Muller

A species of the open prairie but of little importance about Winnipeg. Hearle (9) states that this species is one of the major pests of the prairies, but in the immediate neighborhood of Winnipeg it is certainly not numerous. Adults have been taken on open prairie and in wooded sections on the outskirts of the area. Dyar (2) reports the taking of this species at Winnipeg by F. Knab on June 22, 1907. It was not taken after July 16 during this survey.

The larvae appear during May, and emergence is complete by the end of June. They have only been taken from deep, stagnant ditches well shaded by willows and heavily grown with hay. Found associated with *Aedes canadensis* Theo.

Aedes hirsuteron Theobald

This species occurs here in the form known as *vinnipegensis*, distinguished by the gray mesonotum with a dark brown median stripe and by a brown dot each side of the median mesonotal stripe.

The adults persist until about the middle of July but in wet seasons will be found in August. In the suburbs of Winnipeg they are often an annoying pest in the evenings. They have been observed swarming over high hedges just at dusk and are known to enter houses. This species is a persistent biter although its bite is not as severe as that of some other aedines such as *vexans*. Their distribution is local even within such a restricted area as Greater Winnipeg.

The larvae have been taken from May 10 to June 15 from exposed roadside ditches in which the water temperatutre was 12 to 13 degrees (C). Since, however, the adults have been encountered in wooded sections, it is suggested that the larvae may be found breeding also in woodland pools. Various attempts to find them in such a habitat were unsuccessful. The larvae are found associated with *Aedes campestris* D. and K., *Aedes cinereus* Mg. and *Aedes fitchii* F. and Y.

Aedes impiger Walker

No specimens were taken. Dyar (2) reports the finding of this species at Winnipeg by F. Knab on June 22, 1907. This is the only record from Winnipeg.

Aedes intrudens Dyar

Distinguished by its dull brown colour and bronzy-brown mesonotum with two narrow, darker median lines. The adults of this species persist from the beginning of June until the middle of July, but they are not a serious pest. They enter houses and barns, and their bite is severe.

The larvae were taken only on one occasion, from a roadside ditch filled with water from melting snow, the water being at 19 degrees (C). Found associated with *Aedes cinereus* Mg., *Aedes dorsalis* Mg., *Aedes spencerii* Theo., and *Aedes vexans* Mg.

Aedes nigromaculis Ludlow

The adults of this species are well-marked, having a white ring on the proboscis, broad basal white bands on the tarsi, and a broad brown median stripe on the mesonotum. The species is rare and of little importance about Winnipeg. No adults were taken.

Larvae were found on only one occasion, on August 18 in a roadside ditch filled with water from a recent rain. Associated with *Aedes dorsalis* Mg., *Aedes vexans* Mg., *Culex tarsalis* Coq., and *Culex territans* Wlk.

Aedes riparius Dyar and Knab

No adults have been found, and the species is of no importance in Winnipeg, at least during comparatively dry seasons. However, Dyar (2, 3) reports the finding of this species in this locality by F. Knab on June 21, 1907 and again in large numbers by Dyar in 1923.

The larvae have been taken from roadside ditches from May 2 to May 16 associated with *Aedes spencerii* Theo. and *Aedes dorsalis* Mg.

Aedes spencerii Theobald

Recognized by the black and white scales on the wings, those on the first, third and fifth veins being completely black. The scales over the roots of the wings and around the antescutellar space are yellow.

One of the dominant early spring species in the Winnipeg area. The adults appear early in the spring and persist almost all summer, although after the middle of June they are not present in any great number. They are severe biters and a pest to man and animals wherever they occur.

The larvae are found in temporary exposed pools left by the melting snow, the water being as cold as 12 degrees and as warm as 30 degrees (C). The first collection of larvae was made on May 12 and the last from an isolated pool on August 18. Tully (17) found that the eggs do not all hatch at the first submergence. Even so, the finding of larvae in August is unusual since they are seldom found after the middle of June. The larvae were taken most often in association with *Aedes cinereus* Mg., *Aedes dorsalis* Mg., and *Aedes vexans* Mg.

Table 2. Variation in larval structures of *Aedes vexans* Mg.

	Sample A		Sample B		Totals	
	No. of specimens	%	No. of specimens	%	No. of specimens	%
1. With all the characters of *Aedes vexans* Mg. as given in the literature	120	35.8	77	62.2	197	42.9
2. Upper head hairs 5 and 4	2	.6	4	3.2	6	1.4
3. Lateral abdominal hairs multiple on 1st to 4th segments; double on 5th and 6th	8	2.4	3	2.4	11	2.4
4. Lateral abdominal hairs multiple on 1st to 3rd segments; double on 4th and 5th; single on 6th	5	1.5	2	1.6	7	1.5
5. Upper head hairs 5; lower 2; lateral abdominal hairs multiple on 1st to 3rd segments; double on 4th and 5th; single on the 6th	7	2.1	0	0	7	1.5
6. Upper and lower head hairs multiple	25	7.4	10	8.1	35	7.7
7. Upper and lower head hairs multiple; lateral abdominal hairs multiple on the 1st to 4th segments; double on 5th, single on 6th	50	15	7	5.6	57	12.4
8. Upper head hairs 5 and 4; lower 2; lateral abdominal hairs multiple on 1st to 4th segments, double on 5th, single on the 6th	8	2.4	1	.8	9	1.9
9. Upper head hairs 5 and 4, lower 2; lateral abdominal hairs multiple on the 1st to 3rd, double on the 4th and 5th, single on 6th	6	1.8	1	.8	7	1.5
10. Head hairs multiple; lateral abdominal hairs multiple on the 1st to 3rd, double on 4th and 5th, single on the 6th	104	31	19	15.3	123	26.8
	335	100	124	100	459	100

Under each variation, unless otherwise stated, the remainder of the characters are as given in the literature.

Aedes vexans Meigen

This little black and white mosquito is by far the most serious mosquito pest of the Greater Winnipeg area. About thirty per cent of the total number of specimens collected belonged to this species. It is a severe biter that emerges early in the summer and remains until early September, when the first frosts appear. It is often present in such numbers that remaining out-of-doors in the evenings is impossible. The control measures of the Winnipeg Anti-Mosquito

Campaign are directed mainly against this species. It has been observed swarming around street lamps at night.

All the specimens examined had a few white scales on the wings at the base of the costa and the first vein. There was considerable variation in their size.

There are many variations in the characters by which the larva of this mosquito is distinguished from other aedines, so many in fact that it has been deemed worthwhile to put them down in tabular form. This is done in Table II which gives the variations found in two samples from two different habitats. Sample A was taken from a woodland pool well grown with vegetation and protected from the wind by willows and high deciduous trees. Sample B was taken from an exposed railway ditch. There is evidence here to support the contention of Ginsburg (5, 6, 7) that a species should be described not from a few individual specimens but from a whole population.

The first collection of larvae was made on May 15 and the last on August 18, but these two limits will probably vary considerably depending on weather conditions. Water temperatures varied from 12 to 29 degrees (C) when the larvae were collected. The larvae may be found in almost any kind of habitat except open bogs.

A species which adopts so many different habitats will be found associated with a large number of different species. In this survey *Aedes vexans* was found associated most often with *Aedes canadensis* Theo., *Aedes dorsalis* Mg., *Culex tarsalis* Coq., *Culex territans* Wlk., and *Theobaldia inornata* Will.

Anopheles maculipennis Meigen

The four dark patches on the wing veins and the coppery spot at the apex of the wing serve to distinguish this species.

The females overwinter in houses and any place where they can get protection from the frost. They appear active in the houses early in May for about two weeks, after which they disappear, evidently to lay their eggs and die. This species is not a serious pest but its presence so early in the year in houses arouses attention. It is never present in large numbers.

The larvae have been found at the grassy edges of Sturgeon Creek, a slow-flowing, clear stream on the outskirts of the city, and in grassy permanent sloughs. They appear early in July when the temperature of the water is at about 20 degress (C), doubtless from eggs laid by the overwintering females that are noticed in May. Emergence continues until frost kills the remaining larvae and pupae. Taken in association with *Culex tarsalis* Coq., *Culex territans* Wlk., and *Culex apicalis* Adams.

Anopheles punctipennis Say

The presence of yellowish-white spots on the wings, one being on the costal margin, serves to separate this species from *maculipennis*. It is very rare about Winnipeg and was taken on only one occasion from a lily pond in the city on August 2. Associated with *Culex territans* Wlk.

Culex apicalis Adams

This small *Culex* is easily recognized by the apical segmental bands on the abdomen. It is not numerous and is not known to feed on man. It has been taken well within the city but does not enter houses.

The larvae of this species were taken between June 17 and September 12. Different weather conditions would probably alter these two limits. It seems to prefer cool, permanent pools either shaded or in long grass. Found associated with *Culex tarsalis* Coq., *Culex territans* Wlk., and *Theobaldia inornata* Will.

Culex tarsalis Coquillett

The adults of this species appear early in July and persist until well on into September, depending on the weather. They overwinter as adults but are

rarely seen in the spring. Specimens have been taken in June. They often become numerous and if conditions are favourable constitute a major pest. They bite readily during the day and are often troublesome to small children.

The larvae of this species, like those of *Aedes vexans* Mg., show considerable variation, especially in the number of tufts on the siphon which may vary from four to six pairs. The tufts on the siphon are always in line. The larvae have been taken from permanent pools and artificial receptacles such as rain barrels, fish ponds and lily ponds. Water temperatures ranged from 15 to 29 degrees (C). Larvae were taken from July 4 till September 20 and probably can be found later than this. Taken in association with *Culex territans* Wlk., *Aedes vexans* Mg., and *Theobaldia inornata* Will.

Culex territans Walker

After *Aedes vexans* Mg. and *A. dorsalis* Mg., this species is probably the most important mosquito pest in the area. About eighteen per cent of the total number of specimens collected belonged to this species. This species overwinters in the adult stage and, as in the case of *tarsalis*, has not been seen early in the spring, the earliest record of adults being June 26. The females bear a strong resemblance to those of *Culex pipiens* L. The two white patches on the mesonotum of fresh specimens and the light coloured scales around the roots of the wings and the antescutellar space serve to distinguish it from *pipiens* in which the spots and light scales are absent.

The larvae are easily distinguished from all other culicine larvae by the long single hairs on the breathing siphon. They were taken between June 27 and September 20 from permanent and semipermanent habitats as well as from water barrels. Water barrels seem to be the favourite breeding-place. The temperature of the water in which the larvae were found ranged from 15 to 30 degrees (C). Larvae were taken in association with thirteen other species but principally *Aedes vexans* Mg., *Culex tarsalis* Coq. and *Aedes dorsalis* Mg.

Taeniorhynchus perturbans Walker

Only one female was collected in the course of this study. It was taken in a wooded area on the south side of the city. This is not a common species about Winnipeg, and various attempts to find its breeding place have failed. The single specimen was taken on July 19.

Theobaldia impatiens Walker

This is another typical woodland species which is rare about Winnipeg. The adults are large and easily recognized by the two spots on the disc joined to the antescutellar space by fine pale lines. They overwinter, but the hibernating quarters have not been observed.

Only one collection of larvae was taken, and that on August 1 from a dark well-shaded lily pond filled with rain water and well within the city. The pool was built of concrete, and there was no vegetation present when the larvae were collected. Associated with *Culex tarsalis* Coq. and *Culex territans* Wlk.

Theobaldia inornata Williston

A large brown mosquito with the scales of the wings yellow and black or brown, especially along the costal margins. This species is common and troublesome in the Winnipeg district, especially late in the season. Adults appear in May and remain for the duration of the summer.

The larvae were collected between May 21 and September 20 in water with temperatures ranging from 14 to 30 degrees (C). They prefer cool shaded pools, permanent, semipermanent or artificial. Associated with *Aedes dorsalis* Mg., *Aedes vexans* Mg., *Culex tarsalis* Coq. and *Culex territans* Wlk.

SUMMARY

A brief outline is given of the topography, vegetation and climate of the Greater Winnipeg area. The methods are described by which the specimens were

obtained, reared and identified. The species occurring are grouped according to their importance as pests and the habitats and times of emergence of each are given as far as is known for this area. The twenty-two species known to occur in the Greater Winnipeg area are listed and a brief account given of each.

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THREE ASTER-FEEDING COLEOPHORIDS AND THEIR ALLIES (LEPIDOPTERA) *

BY J. McDUNNOUGH,
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In the past two years three distinct types of Coleophorid cases have been found in the Ottawa region in the early spring, attached mostly to the leaves of *Aster tradescanthi* or allied, thin-leafed species. Small series of moths have been bred from all three types of cases, the adults appearing in late June or early July. As the species are new to our Canadian fauna and as the identification of one of them has involved some interesting comparisons with very closely allied forms, which appear to have specific — or at least subspecific — value, I am presenting the results obtained from my studies of these moths in the following article.

Coleophora granifera Brn.

Figs. 1, 4.

Coleophora granifera Braun, 1919, Ent. News, XXX, 130.

A single case of this species was found on a tree trunk in the western part of Ottawa in 1942 which produced a male on June 15. In 1943 eight cases

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were discovered in late May on the leaves of *Aster tradescanthi* or an allied thin-leafed *Aster,* both in the western and the eastern sections of the city; of these four emerged (1 ♂, 3 ♀) in the latter part of June. Our specimens — especially the males — have the primaries rather more suffused with brown than Dr. Braun's type series and in consequence show less of the dark striae on a paler ground; however the larval cases agree absolutely with the original description and both male and female genitalia correspond with those of a pair of paratypes of *granifera* kindly donated by Dr. Braun; she informs us that the amount of strigation on the primaries of her series is very variable so that it is most probable that, when more material is available, a similar range of variability will be disclosed in our Canadian specimens.

Male Genitalia. Sacculus rather weak; there is no marked differentation between ventral and caudal margins, the ventral edge curving gently dorsad and terminating in a short, triangular, outwardly directed tooth from the dorsal side of which a long curved prong arises, directed caudad, and paralleling for half its length the lower, outer margin of the clasper. Clasper short, not exceeding the apex of the sacculus-process. Valvula large, bluntly triangular, but rather weak and sparsely setose. Gnathos oval. Aedeagus with a long dorsal spine arising from the base of the left chitinous rod; this rod is weak, tapering, and only 2/3 the length of the right rod. The right rod is broad basally, narrowing and bending downward at half its length, forming a flat curving bar which terminates, in the region of the valvula-apex, in a flat blunt tooth, jutting out to the right. Vesica unarmed.

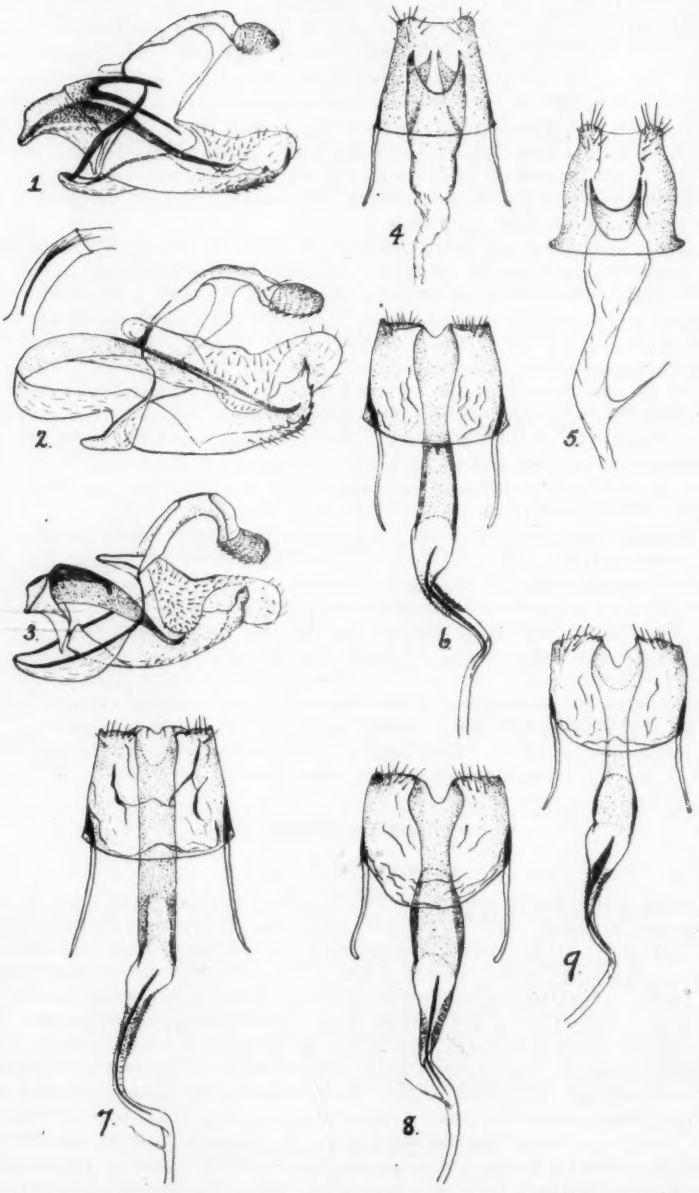
Female Genitalia. Genital plate somewhat higher than broad with the lateral edges straight and slightly inwardly oblique; they project slightly beyond the straight caudal edge of the plate, forming rounded and feebly setose knobs. Ostium situated centrally on the plate, forming a deep V with rather rounded apex. The initial chitinized portion of the ductus bursae forms a long rectangle with somewhat rounded cephalic margin and a slight narrowing of its walls shortly before same. It extends well cephalad of the margin of the genital plate and from its caudal end sends backward two pointed processes, broadly based on the laterodorsal walls, which almost meet in the median line of the ostium on a level with its outer angles. The balance of the ductus bursae is formed by a long, straight membranous tube. Bursa membranous, unarmed.

Coleophora asterosella n. sp.

Figs. 3, 5.

Palpi white, the second joint laterally and the third joint ventrally shaded with smoky; terminal tuft of second joint improminent. Head and thorax white, with slight tinge of gray around bases of patagia. Antennae white, non-annulate. Primaries white, streaked longitudinally with brown and with very sparse smoky sprinkling which in the apical area tends to collect on the brown streaks and deepen their color. Basal third of costal edge finely smoky; there is a fine, subcostal, brown streak extending from base of wing to costa at about ½; another streak arises in the cell, somewhat basad of the end of the subcostal streak and ends on costa at 2/3; this is followed in the apical portion of wing by another short parallel streak; a broader streak runs from base of wing along cubitus to apex of wing, giving off a short costo-apical branch, parallel to the two previous streaks; before the branching this cubital streak is split longitudinally for a short distance by a very fine white line. An obscure fine brown line runs through the fold, and along vein 1 there is a broader brown streak which continues along outer margin to apex of wing. Costal fringes white; apical fringes light fawn and inner fringes light smoky. Secondaries smoky with similarly colored fringes. Fore and mid-legs white outwardly, brown inwardly; hind tibiae white, tufted with white hair and with a fine dark longitudinal line.

PLATE VII.



Male Genitalia (left clasper removed) of 1. *Coleophora granifera* Brn., Ottawa, Ont.; 2. *Coleophora asterophagella* n. sp., Paratype; 3 *Coleophora asterosella* n. sp., Holotype.

Female Genitalia of 4. *Coleophora granifera* Brn., Ottawa, Ont.; 5. *Coleophora asterosella* n. sp., Allotype; 6. *Coleophora annulicola* Brn., Paratype; 7. *Coleophora asterophagella* n. sp., Allotype; 8. *Coleophora laurentella* n. sp., Holotype; 9. *Coleophora vancouverensis* n. sp. Allotype.

Expanse 13-14 mm.

Male Genitalia. Sacculus large, its ventral margin curving gently into the caudal margin which terminates in a broad irregular dorsal process, extending 2/3 across the clasper, slightly recurved apically and with a small excavation on its outer edge near base. Clasper rather short and chunky, extending however, well beyond apex of sacculus. Valvula large, strongly setose, with broad, rounded apex. Gnathos shortly oval. Aedeagus rather short, broad basally, and gradually tapering; the two lateral supporting rods are very broad and almost conjoined at their bases, the right rod being short and terminating bluntly before ½, the left rod bulging to the left beyond base, then downcurved, tapering and ending in a sharp point bent to the right; no other armature. Vesica armed with a minute piece of chitin, resembling a small spine.

Female Genitalia. Genital plate helmet-shaped, slightly tapering caudally; the caudal margin rather straight with the rounded lateral lobes widely separated and setose apically. Ostium situated near centre of plate, broadly semicircular. The ductus bursae is membranous, the initial portion forming a rather broad bulb which tapers into a medium-sized straight tube from the cephalic end of which the ductus seminalis is given off; beyond this the tube narrows and becomes twisted and finely spiculate, straightening out into its narrowest portion before joining the bursa which is small and unarmed.

Holotype — ♂, Billings Bridge, Ottawa South, Ont., July 2, 1943 (J. McDunnough) (Bred from *Aster tradescanthi*); No. 5475 in the Canadian National Collection, Ottawa, Ont.

Allotype — ♀, same data, July 13.

Paratypes — 6 ♂, 3 ♀, same data, July 5, 8, 7, 12 (♂'s), 13, 14, 16 (♀'s); 2 ♂, Ottawa South, June 30, July 5, 1941 (bred from *Aster*).

The species would appear to be best placed near *sparsipuncta* Heinr.

The larval case is 10-12 mm. long, smooth, cylindrical, tapering apically, where it is rather pinched in and two-valved. The color is a pale ochreous or whitish somewhat darker above the mouth, due to a sprinkling of small, black, particles. These cases occurred in spring on the underside of the leaves of *Aster tradescanthi* in a rather marshy field, and, while by no means common, could be readily perceived, the pale cases standing out at almost right angles from the leaf-surface.

The third species, according to the type of larval case and the genitalia of both sexes, is evidently very closely allied to *annulicola* Brn., described from the vicinity of Logan, Utah, and represented in our collection by a pair of paratypes. Judging by other material before me there appears to be a small group of forms — which might be termed the *annulicola*-complex — in which the larval cases and adult genitalia are practically identical but which show readily distinguishable characters in forewing coloration and maculation; in certain instances there is also a difference in larval food-plant. *Annulicola* was bred by Dr. Braun from cases found on both *Aster* and *Solidago* species. The description of the case is excellent it being "cylindrical, tapering but little toward the flatly compressed and longitudinally split apex. The case is about 18 or 19 mm. in length and is made of a series of many ring-like pieces of leaf epidermis." While evidently rather variable in maculation the forewing of the male is of a general brown ground color with faint, but distinct, whitish longitudinal striae; the female is paler in ground color and the striae are more evident.

In our Ottawa series of specimens, which are matched by a few adults I bred in 1938 at Riding Mt. Park, Man., from similar cases on an *Aster* species, the forewing in both sexes is a rather even dark brownish-fuscous, with at times the merest suspicion of somewhat paler striae before the apex. A third member of the group was bred by me in 1933 from similar types of cases found on what was identified for me as a *Grindelia* species along the sea-shore of Vancouver Island, B.C. The adults have a light whitish-gray forewing (practically white in

the females) with sharply defined, longitudinal, brown striae of the usual type; the whole insect, in consequence, appears very much paler than the two previously mentioned forms. Finally a single, similarly pale female was bred in 1941 from a case found attached to a coarse grass leaf (probably quite accidentally) on the edge of a bog at Eel River, northern New Brunswick; this specimen, while undoubtedly extremely similar to the Vancouver Island form can hardly have been a *Grindelia*-feeder as this genus of plants is not found in eastern Canada.

As already noted, genitalic differences between these four forms, especially in the males, are extremely slight; in the females certain differences, however, may be noted and while my material at the present time is inadequate to check really properly on the value of such differences, I feel that no great harm will be done if the following names are applied in a specific sense.

Coleophora asterophagella n. sp.
Figs. 2, 7.

Palpi outwardly fuscous with ventral edge of 1st and 2nd joints whitish, inwardly whitish; second joint with well-developed pointed tuft of hair apicoventrally. Head, thorax and basal antennal joints light grayish-fuscous. Antennae otherwise white, distinctly ringed with brown in the male, less so in the female. Primaries rather evenly brownish-fuscous with mere traces of paler streaks before apex of wing and through the fold. Costal and apical fringes concolorous, other fringes deep smoky. Secondaries entirely deep smoky. Beneath deep smoky. Expanse 13 mm.

Male Genitalia. Sacculus well-developed, the apical half of ventral margin bent inward and gradually curving into a long, upright costal margin, the edges of both being irregularly and variably dentate; costal margin terminating in a single strong tooth, slightly bent inward and extending fully halfway across clasper; dorsal margin short and unarmed. Clasper rather weak, extending shortly beyond sacculus. Valvula large with broad, rounded apex, covered with short setae. Basal portion of aedeagus with a long cephalic curve; of the two chitinous rods the left one is 1/3 shorter than the right one, narrow and ending in a point; the right rod broadens towards apex, bends somewhat downward with the apex curved to the right, forming a species of flattened tooth; vesica armed with a small bunch of fine cornuti, closely appressed except at their apices. Gnathos shortly oval.

Female Genitalia. Genital plate well chitinized and subrectangular, the lateral edges slightly sloping inward and terminating caudally in short, rounded knobs; caudal edge irregularly waved, sparsely haired, and with a *central very shallow* and rounded excavation; the whole plate is irregularly creased, especially centrally and above the weakly rounded cephalic margin. Ductus bursae arising from the middle of the caudal margin of plate, very slightly expanded at inception, then forming *a broad straight chitinized tube,* extending well beyond cephalic margin of plate. This is followed by a short bulb-shaped membranous portion which rapidly narrows into a thin tube, the sides of which are strengthened for a short way by chitinous strips, and are very feebly spiculate; centrally in this section there is a thin, chitinous band which I have termed on other occasions 'watch-spring-like'. Bending caudad and then cephalad this section is continued by a long, thin, straight, membranous tube which, after describing 2 or 3 convolutions, enters the small bursa which is armed with a fine curved spine-like signum on a broad chitinous base.

Holotype — ♂, Merivale, Ont., July 2, 1943 (G. S. Walley) (Bred from *Aster*); No. 5476 in the Canadian National Collection, Ottawa, Ont.

Allotype — ♀, East Ottawa, July 9, 1943 (J. McDunnough) (bred from *Aster*).

Paratypes — 2 ♂, same data as Holotype, July 2 and 14, 1943.

As compared with the genitalia of *annulicola* the only difference I have

noted in the males is that the left rod of the aedeagus is shorter in the present species, this rod in *annulicola* extending almost to the apical bend of the right rod. The spining of the caudal margin of the sacculus cannot, apparently, be used as a differentiating feature as these spines appear to be quite variable, both in size and arrangement. In the female genitalia — as far as my material permits me to judge — the main differences consist in the much smaller median excavation of the caudal margin of the genital plate and the straighter nature of the initial portion of the ductus bursae, the sides being parallel, whereas in *annulicola* they are sinuate, the ductus being, in consequence, more hourglass-shaped.

Coleophora vancouverensis n. sp.
Fig. 9

Palpi in ♂ smoky outwardly, white inwardly and along the ventral margin of the 1st and 2nd segments; in ♀ largely whitish, except the tuft; apico-ventral tuft of 2nd segment as in previous species. Head and thorax pale grayish-white. Antennae white, in ♂ distinctly annulate with brown. Primaries whitish, striped longitudinally with light brown, these stripes as follows; a subcostal stripe ending beyond middle of costa and followed by two parallel oblique stripes from cell to outer half of costa; a stripe along lower edge of cell, splitting toward end of cell, the lower branch continuing to outer margin and along it to apex of wing, the upper one splitting into two thick stripes, partly confluent, and parallel to the two previously mentioned ones; a stripe through the fold to outer margin and another parallel one just above inner margin. Fringes and hindwings in ♂ smoky brown. Female paler, with the brown stripes less evident and at times obsolescent; fringes almost white. Expanse 13-15 m.m.

Male genitalia as in *annulicola*. Female genitalia with the genital plate rather shorter than in *annulicola*. the median excavation of caudal margin is much deeper than in either *annulicola* or *asterophagella* but the lateral knob-like projections less evident. The initial chitinized portion of the ductus bursae is somewhat bulbous, then narrowing and again expanding slightly, the lateral edges, in consequence, being feebly sinuate in contradistinction to the straight edges found in *asterophagella*.

Holotype — ♂, Comox, Vancouver Is., B.C., July 27, 1933 (J. McDunnough) (Case on *Grindelia*); No. 5494 in the Canadian National Collection, Ottawa, Ont.

Allotype — ♀, same data.

Paratypes — 1 ♂, 4 ♀, same data.

The cases are somewhat paler and less distinctly annulate as compared with the *Aster*-feeding species.

Coleophora laurentella n. sp.
Fig. 8

Female. Palpi entirely whitish, with similar apical tufting on 2nd joint to that of allied species. Head and thorax white with a faint ochreous tinge. Antennae entirely white. Primaries white, streaked rather definitely with light brown as in the previous species. Hindwing light smoky. All fringes white with faint smoky tinge. Expanse 13 mm.

Genitalia. Much as in the preceding species but the cephalic margin of genital plate more convex and the median excavation of the caudal margin more rounded apically. The bulbous initial portion of the ductus bursae has more bulging sides and this whole section is broader and stouter than in the allied species.

Holotype — ♀, Eel River, N.B., July 13, 1941 (T. N. Freeman); No. 5495 in the Canadian National Collection, Ottawa, Ont.

Evidently very close to the preceding species. Until more material can be secured its status is rather doubtful.

A CORRECTION REGARDING THE FEMALE SEX OF *COLEOPHORA QUADRUPLEX* McD. (LEPIDOPTERA) *

BY J. McDUNNOUGH,
Ottawa, Ont.

Coleophora quadruplex McD.
1940, Trans. Roy. Soc. Can., Sect. V. 62.

In my original description of the above species I rather doubtfully associated with the male holotype and paratypes two females, largely on account of similarity of locality data; the genitalia of one of these was figured on Plate III, fig. 6. I now find that this association was incorrect and that the name *quadruplex* must be restricted to the male sex of the original description.

In August, 1943, I took long series of what are undoubtedly both sexes of *quadruplex* flying at dusk in the vicinity of Parrsboro, N.S., around yarrow (*Achillea millefolium*); in the daytime they could be flushed out of their resting places among the lower leaves of such plants. As I failed to find them with any other plant association it seems fairly certain that yarrow will prove to be the larval food-plant, although at the time it was too late to secure any cases. The corrected description of the female genitalia is as follows:

Fig. 1, Female genitalia of *C. quadruplex* McD.

Female Genitalia. Genital plate rather narrow, higher than broad, the two lobes well separated by a membranous area; caudal margin feebly and irregularly dentate, the two edges of the lobes forming an open V in the median area. Ostium broad, semicircular, situated slightly cephalad of the middle section of the genital plate. The initial portion of the ductus bursae is wide, with parallel sides extending to a level with the cephalic margin of the plate and then broadening into a short, weakly chitinized, bulb-shaped section. This narrows down to a fine tube, which for a short distance is strongly spiculate and contains the usual watch-spring-like band; a rather broader, somewhat twisted, membranous section follows, showing a few spicules at its apical end and leading in turn into a narrow, terminal section which forms 3-4 convolutions before entering the globular bursa. Signum a curved, rather blunt spine, arising from a chitinous plate; there is also a small, weak, feebly spiculate chitinous bar present on the bursa-membrane.

A search through our unidentified material resulted in the discovery of

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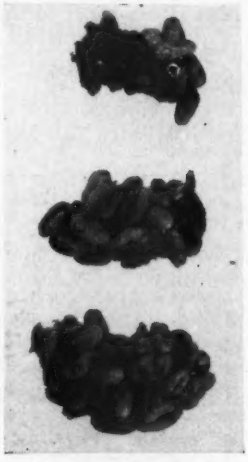
four females with similar genitalia to those of my Parrsboro specimens. One of these bore the same data as the Holotype of *quadruplex* (White Pt. Beach, N.S., Aug. 14, 1935); another specimen was from Norway Bay, Que., July 21, 1939 and two others from Ottawa, July 19, 1931; the species is evidently widespread.

As to the indentity of the misassociated females I am unable to place them definitely at the moment but they might easily fall under *intermediella,* according to size.

AN UNUSUAL EGG LAYING SITE FOR THE TWO-STRIPED GRASSHOPPER

The two-striped grasshopper, *Melanoplus bivittatus* (Say), generally confines its egg laying to ditches, drift soil and crop margins, but during the autumn grasshopper egg survey in southern Saskatchewan in 1942, this species was observed ovipositing in exposed piles of wheat left in the grain fields at harvest time. Clustered on the sloping sides of these large piles of wheat were as many as 25 to 50 *M. bivittatus* adults per square yard, as well as a few adult *M. mexicanus* (Saussure) and *M. packardii* Scudder. During periods of weather which



Egg Pods of *Melanoplus bivittatus* (Say).

were too cool for grasshopper activity elsewhere and even during a cold rain, many *M. bivittatus* females were observed ovipositing in the wheat. A large number of pods were subsequently recovered, of which three are shown in the photograph. Due to a high content of green weed seeds the wheat was heating and the surface of the pile was about 80 degrees F. as contrasted to an air temperature of about 50 degrees F. The grasshoppers were attracted to the piles of wheat during cool weather, since such concentrations on these piles were not observed during warm weather. While resting on the heating wheat the temperature was sufficiently high to stimulate them to oviposit.

This abnormal behavior is paralleled to some extent by the grasshopper habits observed during the autumn survey. Temperature influenced, in an exceptional degree, the selection of oviposition sites in 1942. Unusual concentrations of egg pods of *M. mexicanus,* as well as those of *M. bivittatus,* were found in small openings in the crop where grasshoppers were exposed to the sun but protected from the wind. This behavior evidently resulted from heavy crops and the cool weather which prevailed throughout much of the autumn.

W. B. Fox,
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A NEW SPECIES OF *PSEUDOHAZIS* FROM WASHINGTON (LEPIDOPTERA, SATURNIIDAE)

BY CAPTAIN W. P. MEDLAR,

San Diego Society of Natural History

Pseudohazis washingtonensis n. sp.

Male lappets vivid deep yellow. Dorsal and ventral sides of abdomen deep bright yellow with a narrow black band on the anterior margin of each segment. The appearance of the species is intermediate between *eglanterina* and *hera,* differing most conspicuously from these two in wing color. Primaries pale yellow faintly tinged with pink, but much less intense than in *eglanterina.* Secondaries brilliant yellow. Antemedian and postmedian black bands narrow and limited to a more regular pattern than in *eglanterina* or *hera.* Width and pattern of the bands constant. The black discocellular patches on both wings are not coalesced with the postmedian band as in *hera* and are more rounded than in that species. Tinge of black at the base of the secondaries in *hera* and *eglanterina* lacking. Underside of both of wings uniformly bright yellow with black markings corresponding to those on upper surface.

The three females among the twenty-nine specimens studied closely resemble the males in all respects excepting the antennae, where the usual sexual difference in this genus is apparent.

Holotype: ♂, Brewster, Washington, August, 1940, J. C. Hopfinger, collector; San Diego Society of Natural History, San Diego, California.

Allotype—♀, same data.

Paratypes—2 males, Division of Entomology, Department of Agriculture, Ottawa, Canada; 2 males, Los Angeles Museum, Los Angeles, California; 2 males, U. S. National Museum, Washington, D. C.; 2 males, Academy of Natural Sciences, Philadelphia, Pennsylvania; 1 male, 1 female, San Diego Society of Natural History, San Diego, California; 2 males, California Academy of Sciences, San Francisco, California; 3 males, 1 female, J. C. Hopfinger, Brewster, Washington.

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